THE RANKING OF POLICY INTERVENTIONS UNDER FACTOR MARKET IMPERFECTIONS : THE CASE OF SECTOR-SPECIFIC STICKY WAGES AND UNEMPLOYMENT[1]

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The ranking of alternative policy interventions for an open economy characterised by factor market imperfections has been the subject of active analysis in recent years.

The imperfections analysed hitherto can be distinguished into two major types : (1) where the source of imperfection is a (distortionary) wage differential between sectors, while the wage is perfectly flexible; and (2) where there is no wage differential between sectors but the (uniform) wage is "sticky" and unemployment follows. The former class of problems was first analysed by Hagen (1958) and has been the subject of further welfare analysis but Bhagwati and Ramaswami (1963), Kemp and Negishi (1969) and has been treated more fully in Bhagwati, Ramaswami and Srinivasan (1969)[2]. The latter problem was raised by Haberler (1950) and treated further in Bhagwati (1968), Johnson (1965) and has been systematically explored by Brecher (1970)[3].

A recent model of Harris and Todaro (1970) has the interesting property that it combines *both* the sticky-wage and the wage-differential phenomena as the *outcome* of a sticky wage in one (urban) sector. By postulating that the wage in the other (rural) sector will be equated with the *expected* wage in this (urban) sector, the expected wage being the actual wage adjusted for the probability of securing the wage/job

[1]The research underlying this paper was supported by the National Science Foundation. We have benefitted from comments received at seminars at Harvard, Minnesota and Stanford, as also from the suggestions of Peter Diamond and Max Cordon. This paper is dedicated to the memory of Professor P. C. Mahalanobis whose interest in development a problems in general, and in employment in particular, was evident in his own research and contributions to Indian planning.

[2] (1) The "dual" problem of raising the employment of a factor in one sector beyond the level implied by the optimal solution, and ranking different ways of doing this in terms of the loss entailed, has been solved by Bhagwati and Srinivasan (1969). See Bhagwati (1971) for a discussion of the parallel between those different analyses. (2) The "positive" analysis of the various pathologies which result in consequence of the presence of a distortionary wage differential has been attempted by a number of writers recently including the present authors (1971), and a most useful review of this literature can be found in Magee (1972).

[3]A valuable analysis of this problem, where the two-sector model is not the traditional model with primary factors producing two final, traded goods but instead one with an investment good and a consumption good, is by Lefeber (1971).

(which is less than unity in the presence of unemployment), Harris and Todaro essentially solve their system to yield urban unemployment (as the urban labour force exceeds the labourers who will be employed at the "sticky" wage) *and* a differential between the actual wages in the two sectors (as only the actual rural wage and the *expected* urban wage are equalised).

In this paper, we propose to analyse this model of market imperfection and rank alternative policy interventions in the presence thereof. Since the model permits unemployment, we also investigate the optimality properties of alternative policies in regard to their effects on employment levels, whereas Harris and Todaro formally discussed welfare improvement and maximization in terms of a social utility function defined on aggregate consumption of goods alone.[4]

1. The model

The basic Harris-Todaro model consists of a set of relations which can be stated as follows.

There are two commodities (A and M), produced in quantities X_A and X_M, using L_A and L_M units of labour, with strictly concave production functions [5]

$$X_A \leqslant f_A(L_A) \qquad \dots \quad (1)$$

$$X_M \leqslant f_M(L_M). \qquad \dots \quad (2)$$

Next, with the fixed, overall labour supply assumed by choice of units to equal unity, we have :

$$L_A + L_M \leqslant 1 \qquad \dots \quad (3)$$

$$L_A, L_M \geqslant 0 \qquad \dots \quad (4)$$

to complete the "supply" side of this general equilibrium system. It is well known, of course, that if we now add a standard utility functon :

$$U = U(X_A, X_M) \qquad \dots \quad (5)$$

where U is concave with positive marginal utilities for finite $[X_A, X_M]$, this function would be maximised when :

$$\frac{U_1}{U_2} = \frac{f'_M}{f'_A} \qquad \dots \quad (6)$$

together with the satisfaction of equalities in equations (1)-(3), (where U_1 and U_2 represent the partial derivatives of U with respect to X_A and X_M respectively and f'_i is the derivative of f_i with respect to its argument, $i = A, M$).[6]

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[4] For an earlier, formal analysis of social utility functions, augmented to allow for "non-economic" objectives such as self-sufficiency, see Bhagwati and Srinivasan (1969).

[5] Thus, implicitly, there is a second factor (K_A, K_M) which yields the diminishing returns to labour input.

[6] We are, of course, ruling out throughout this paper a corner solution, the sufficient conditions for doing this being that $f'_A(0) = f'_M(0) \to \infty$.

A competitive economy will indeed be characterised by this maximum. Figure 1 shows that the production possibility curve will be DE and with $\frac{U_1}{U_2}$ given by (the negative of the slope of) SS', the economy will produce optimally at S. For a closed economy, the reader can thus visualise a tangency of the indifference curve to DE at S; and for an open economy, the reader can visualise the tangency of the indifference curve to SS' at a point other than S, in the usual way.[7]

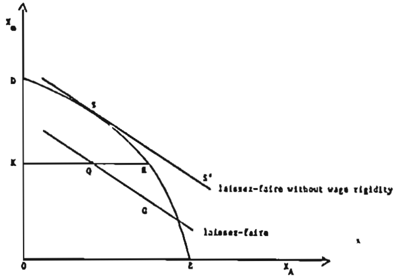

Fig. 1. DE is the production possibility curve when wage rigidity is absent. With the wage rigidity constraint, equilibrium production under *laissez faire* can lie only along RK instead of RD, because equilibrium on RD (excluding R), as at S, implies wage in manufacturing *below* the minimum wage. Q is the *laissez-faire* production point under price-ratio QG, under the wage constraint.

The Harris-Todaro problem of sector-specific rigid wages and resulting unemployment can now be readily introduced. Let the optimal solution above [and at S in Figure 1] be : $X_A^*, X_M^*, L_A^*, L_M^* (= 1-L_A^*)$.[8] Assume now, however, that there is an exogenously specified, minimum-wage constraint in manufacturing, such that :

$$w \geqslant \bar{w} \qquad \ldots \quad (7)$$

where w is the wage in manufacturing, in units of the manufacturing good (M). For a competitive economy, this implies that

$$f_M'(L_M) \geqslant \bar{w}. \qquad \ldots \quad (7')$$

This constraint becomes binding, and S in Figure 1 is inadmissible, when :

$$f_M'(L_M^*) < \bar{w}.$$

[7]In the diagrammatic representation in Figures 1-5, we have depicted alternative equilibria at constant U_1/U_2, thus implying a linear utility function. This also makes the diagrams interpretable as depictions of the production equilibrium for an open economy, with given terms of trade. The formal analysis in the text is, of course, independent of any such restriction of linearity; it does not however extend to the case of an open economy with monopoly power in trade.

The competitive economy, when characterised by this wage constraint, will then experience unemployment of labour. When then have two options to characterise the labour market equilibrium in this situation: *either* assume that the wage in agriculture (A) will be equialised with the wage in manufacturing (M) despite the unemployment; *or* that the wage in agriculture will be equalised with the *expected* wage in manufacturing, the expected and the actual wage in manufacturing being different as the former would be defined as the latter weighted by the rate of employment

$$\bar{w}\,\frac{L_M}{1-L_A}$$

where $L_M < (1-L_A)$ when there is unemployment.

The analysis of Harris-Todaro is based on the latter assumption, so that we can then write the equilibrium production conditions in competition and *laissez faire*, as follows:

$$f'_M = \bar{w} \qquad \ldots \quad (8)$$

$$\frac{U_1}{U_2}\, f'_A = \bar{w}\,\frac{L_M}{1-L_A} \qquad \ldots \quad (9)$$

where we assume, in (9), that the consumption and production price of the agricultural good is identical and equal to U_1/U_2. Given $\bar{w}$, we can then solve (8) and (9) for L_M and L_A, after setting $X_A = f_A(L_A)$ and $X_M = f_M(L_M)$. The *laissez-faire* equilibrium, with unemployment ($L_M < 1-L_A$), will then lie, in Figure 1, along RK (where X_M and hence L_M are fixed at the value that makes $f'_M = \bar{w}$) at Q.[8]

The policy questions that immediately arise are: (i) what is the optimal policy intervention which would restore the economy to optimality at S; (ii) what alternative policies can be used in this model for intervention, and what would be their impact on welfare (as conventionally defined by our utility function) and on unemployment?

2. The basic results

In this model, there are a number of policy options which can be explored; however, many can be shown to be equivalent to one another or to combinations of other policies.

Thus, we will discuss the following policies:

(i) *laissez faire*;

(ii) wage tax-cum-subsidy in manufacturing (M); and

(iii) production tax-cum-subsidy.

[8]It is worth noting that the *laissez-faire* equilibrium would lie along RK even if we assumed actual wages to be equalised between the two sectors.

Note that, as a little reflection will show, the simple structure of the model implies that :

(iv) a wage tax-cum-subsidy in agriculture is equivalent to policy (iii);

(v) a uniform wage tax-cum-subsidy in *all* employment is a combination of policies (ii) and (iii);

(vi) for a closed economy, a consumption tax-cum-subsidy policy is equivalent to policy (iii), i.e. a production tax-cum-subsidy policy[9]; and

(vii) for an open economy, a tariff (trade subsidy) policy would, as usual, be equivalent to policy (iii), i.e. a production tax-cum-subsidy policy, *plus* consumption tax-cum-subsidy policy.[10]

We will proceed to establish the following propositions, which we now illustrate with the usual diagrammatic techniques :

Theorem I : *There exists a unique competitive equilibrium corresponding to each wage subsidy s to manufacturing in an interval $[0, \bar{s}]$. At $\bar{s}$, full employment is reached.*

Thus, imagine in Figure 2 that the *laissez-faire* equilibrium is at Q (as in Figure 1). Succeeding levels of wage subsidies should map out a locus of resulting *production* equilibria, with H representing the full-employment equilibrium, the wage subsidy that leads to it beings $\bar{s}$.[11]

Theorem II : *A wage subsidy (in manufactiring) will exist which will improve welfare over laissez faire.*

Thus, *laissez faire* (i.e. wage subsidy $= 0$) can be necessarily improved upon by *some* wage subsidy. Thus, in both Figures 2 and 3, where we illustrate for the case of a linear utility function (or, equivalently, for the case of a "small," open economy), the curve QH must necessarily lie somewhere to the northeast of QG, whose slope defines U_1/U_2 (or, equivalently, for a small, open economy, the international *and* domestic price-ratio). In fact, such a welfare-improving wage subsidy will exist in the immediate neighbourhood of Q.

Theorem III : *The full-employment wage subsidy may not be the "second-best" wage subsidy.*

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[9]Thus, let $\pi_p = \dfrac{\bar{w}L_M}{(1-L_A)f'_A}$ be the producer's price of the agricultural good, and $\pi_c = \dfrac{U_1(X_A, X_M)}{U_2(X_A, X_M)}$ be the consumption price of the agricultural good. The production tax-cum-subsidy is then defined as $\dfrac{\pi_p - \pi_c}{\pi_c}$, and the consumption tax-cum-sibsidy as $\dfrac{\pi_c - \pi_p}{\pi_c}$.

[10]Thus, if π^* is the international price of the (importable) agricultural good, a tariff at *ad valorem* rate t would imply : $\pi^*(1+t) = \pi_p = \pi_c$.

[11]That increasing wage subsidies in manufacturing should increase X_M is obvious. However, X_A may fall or rise in general ; in the particular case of a linear utility function, however, X_A will fall.

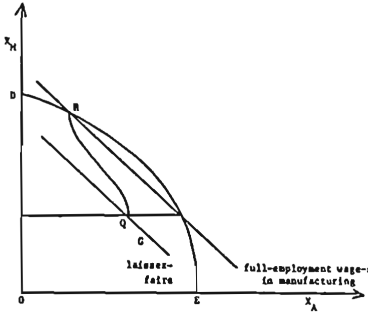

Fig. 2. *DE* is the production possibility curve when the wage rigidity is absent. *Q* is the *laissez-faire* production point under the wage constraint. *QH* is the locus of production equilibria mapped out by successively increasing wage subsidy in manufacturing. Here we have a case where the full-employment wage-subsidy in manufacturing is also at the second-best level.

The wage subsidy that secures full employment may not also be the wage subsidy that yields the "second-best" welfare maximum (for our social utility function). It *is* the second-best subsidy in Figure 2; but in Figure 3, it is not.

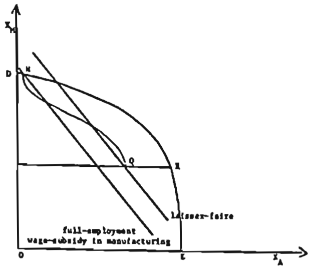

Fig. 3. *DE* is the production possibility curve when the wage rigidity is absent. *Q* is the *laissez-faire* production point under the wage constraint. *QH* is the locus of production equilibria mapped out by successively increasing wage subsidy in manufacturing. Here we have a case where the full-employment wage-subsidy in manufacturing (1) is not the second-best subsidy *and* (2) is also inferior to *laissez-faire*.

Theorem IV : *The full-employment wage subsidy may be inferior to laissez-faire.*

The case where the full-employment-yielding wage subsidy (in manufacturing is inferior to *laissez faire* is illustrated in Figure 3.

Theorem V : *There exists a unique production tax-cum-subsidy which will enable full employment to be reached and which is also the second-best tax-cum-subsidy.*

Figure 4 illustrates the production tax-cum-subsidy, as the difference between RR' (the price-ratio in consumption $= U_1/U_2$) and RR'' (the tangent to DE at R, defining the producer's price-ratio or alternatively the "domestic rate of transformation). Clearly, this is *both* a full employment and the second-best production tax-cum-subsidy.

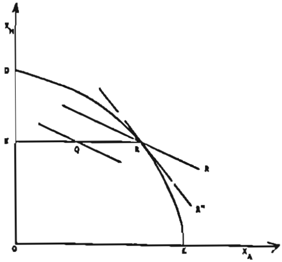

Fig. 4. DE is the production possibility curve without the wage constraint ; KRE is the curve with the wage constraint. Under *laissez-faire*, production equilibrium (at price-ratio RR') is at Q. A production or consumption tax-cum-subsidy, defined by the difference between RR' and RR'' (the tangent to DE at R) will take production to R. This policy, under which the tax-cum-subsidy is being clearly levied at its(second-) best level, will necessarily dominate *laissez faire* (at Q).

Remark : It is also clear that *laissez faire* is necessarily inferior to a production tax-cum-subsidy policy.[12]

Theorem VI : *The second-best wage-subsidy (to manufacturing) and the second-best production tax-cum-subsidy cannot be ranked uniquely.*

Figure 5 illustrates Theorem VI. If the wage-subsidy locus is QH_2, it is clear that the second-best wage-subsidy at H_2 dominates the second-best production subsidy to agriculture at R; and, if the wage-subsidy locus is alternatively QH_1, the second-best wage-subsidy at J is dominated by the second-best production subsidy to agriculture at R.

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[12] Recall here also the equivalence propositions listed at the beginning of this section.

Theorem VII : *The first-best optimum can be reached if both the production tax-cum-subsidy and wage subsidy (to manufacturing) policies are admissible (or any equivalents thereof, including a uniform wage subsidy on employment of labour in both sectors).*

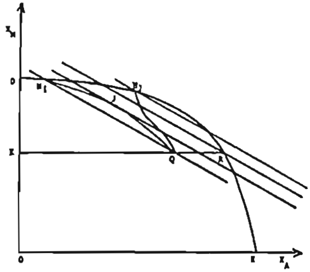

Fig. 5. *DE* is the production possibility curve without the wage constraint; *laissez-faire* equilibrium production is at *Q* with the wage constraint. QH_1 and QH_2 are two *alternative* wage-subsidy-to- manufacturing production loci, derived as in Figure 1. *R* is the equilibrium production that can be reached by a suitable consumption (or production) tax-cum-subsidy. For QH_1, then, the (second-) best consumption tax-cum-subsidy policy (at *R*) will dominate the (second)- best wage-subsidy policy (at *J*), as also of course the full-employment wage-subsidy policy (at H_1). For QH_2, however, the (second-) best wage-subsidy policy (at H_2), which also happens to achieve full employment, will dominate the (second-) best consumption tax-cum-subsidy) policy (at *R*). Thus, the two policies cannot be uniquely ranked, in general.

3. Wage subsidy in manufacturing

Let us now consider the wage tax-cum-subsidy as the policy intervention in this economy. Denoting by s the subsidy per unit of labour employed in manufacturing we find that the equilibrium is now characterised by :

$$f_M = \bar{w} - s \qquad \dots \quad (10)$$

$$\frac{U_1}{U_2} \cdot f_A = \bar{w} \cdot \frac{L_M}{1-L_A} . \qquad \dots \quad (11)$$

Equation (10) assumes that each worker in manufacturing receives remuneration $\bar{w}$, of which only $(\bar{w}-s)$ is paid by the employer and s by the State out of lump-sum taxation. With the consumer and producer price of the agricultural good assumed to be identical, and equal to U_1/U_2, we then have the actual wage in agriculture being equated to the employment-rate-weighted (i.e. expected) wage in manufacturing in equation (11).

It is clear then that, given w and s, we can solve for L_M and L_A from (10) and (11). Thus, given concavity, L_M is determined uniquely by (10) for $0 \leqslant s \leqslant \bar{w}$. Given L_M, X_M is determined and hence both the left and right hand sides of (11) are functions of L_A only.

Now, the right hand side is clearly an *increasing* function of L_A. We next proceed to show that the left hand side is a *decreasing* function of L_A. Note that the derivative of the left hand side with respect to L_A is :

$$\left(\frac{U_{11}U_2 - U_{21}U_1}{U_2^2}\right)(f_A')^2 + \frac{U_1}{U_2} f_A''.$$

Now, U_1, U_2, and f_A' are positive and f_A'' is netative because of concavity of f_A. The term involving the second partial derivatives of U vanishes if U is linear. If U is non-linear in X_A, then its concavity ensures that $U_{11} < 0$. If we assume $U_{12} \geqslant 0$, i.e. the marginal utility of either good does not fall if the consumption of the other good is increased, we will then ensure that the left hand side of (11) is a decreasing function of L_A.[13].

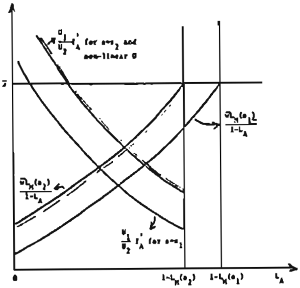

Fig. 6

Noting next that the relevant range for L_A is clearly $\{0, 1-L_M(s)\}$, we can graph the two sides of (11) in Figure 6 for two values of s : s_1 and s_2 ($> s_1$). We now

[13]Alternatively, we could have made a less restrictive assumption i.e. that both goods are normal in consumption. This, with concavity of the utility function, would also suffice to make $(U_{11}U_2 - U_{21}U_1) < 0$ and $(U_{12}U_2 - U_{22}U_1) > 0$.

have to show that, *given s*, the graphs of the two sides of (11) will intersect at a unique value of $L_A(s)$ and to verify that this value lies in the relevant range $\{0, 1-L_M(s)\}$. This is done readily, as follows.

Note first that, because of the concavity of f_M, $L_M(s)$ is an increasing function of s and hence, for given L_A, the right hand side of (11) is an increasing function of s. The partial derivative of the left hand side of (11) with respect to s is :

$$\left(\frac{U_{11}U_2-U_{21}U_1}{U_2^2}\right) f'_A f'_M \frac{dL_M(s)}{ds}$$

which is zero if U is linear in X_A and X_M, and negative if U is non-linear in X_M and concave provided (as we assumed earlier) $U_{12} \geqslant 0$. Thus, the graph of the right hand side of (11) shifts to the left and that of the left hand side either stays put (if U linear in X_A and X_M) or shifts to the right as the subsidy s is increased.

We can next readily demonstrate that a unique *laissez-faire* equilibrium, characterised by unemployment, exists. As noted earlier, the relevant range for L_A, given $s = 0$ is $\{0, 1-L_M(0)\}$. As $L_A \to 0$ $f'_A \to \infty$, and U_1/U_2 either remains constant or increases (given $U_{12} \geqslant 0$). Thus $\lim_{L_A \to 0} \frac{U_1}{U_2} f'_A = \infty$. But $\lim_{L_A \to 0} w \frac{L_M(0)}{1-L_A} = \bar{w} L_M(0)$ $< \lim_{L_A \to 0} \frac{U_1}{U_2} f'_A$. In other words, the graph of the left hand side of (11) lies above that of the right hand side near $L_A = 0$. As $L_A \to 1-L_M(0)$, the right hand side has the value w and the left hand side has the value $\frac{U_1}{U_2} f'_A \Big|_{1-L_M(0),\, L_M(0)}$, i.e. $\frac{U_1}{U_2} f'_A$ evaluated at $L_A = 1-L_M(0)$ and $L_M = L_M(0)$. But this value of $\frac{U_1}{U_2} f'_A$ is less than that at the unconstrained optimum point $L^*_A = 1-L^*_M$, $L_M = L^*_M$. For, from $L^*_M < L_M(0)$ (reflecting the fact that $f'_M\ (L_M(0)) = \bar{w}$ while $f'_M(L^*_M) < \bar{w}$) it follows that $1-L^*_M = L^*_A > 1-L_M(0)$. But

$$\frac{U_1}{U_2} f'_A \Big|_{1-L^*_M,\, L^*_M} = f'_M \Big|_{L^*_M} < \bar{w}. \quad \text{Hence } \frac{U_1}{U_2} f'_A \Big|_{1-L_M(0),\, L_M(0)} < \frac{U_1}{U_2} f'_A \Big|_{1-L^*_M,\, L^*_M} < \bar{w}.$$

This means that, at $L_A = 1-L_M(0)$, the graph of the left hand side of (11) is below that of the right hand side. Hence the two graphs intersect at a unique value $L_A(0)$ which lies between 0 and $1-L_M(0)$. In other words, there exists a unique *laissez-faire* equilibrium characterised by unemployment.

It is then easily seen that, as we introduce and increase a wage subsidy (to manufacturing) s from this unemployment, *laissez faire* equilibrium, the graphs of the two sides of (11) in Figure 6 continue to shift and intersect at an $L_A(s)$ in the interval $\{0, 1-L_M(s)\}$ *until* s attains a value $\bar{s}$ when the two graphs, the horizontal line at w

and the vertical line through $1-L_M(s)$ all intersect at the same point, as shown in Figure 7. Since this implies that $L_A(\bar{s}) = 1-L_M(\bar{s})$, there is clearly full employment at this equilibrium : i.e. at a wage subsidy, $s = \bar{s}$, full employment can be obtained.

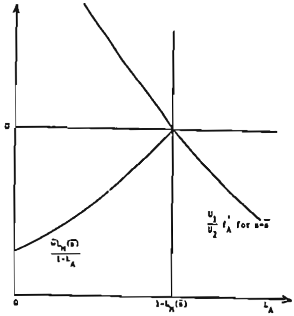

Fig. 7

While the preceding argument establishes the existence of a full-employment-yielding wage subsidy, we now show that : (1) it need not be the second-best wage subsidy, (2) it may not even be welfare-improving over *laissez-faire*; and (3) *some* wage subsidy will always improve welfare over *laissez faire*. To establish these propositions, note that :

$$\frac{dU}{ds} = U_1 f'_A \frac{dL_A(s)}{ds} + U_2 f'_M \frac{dL_M(s)}{ds}.$$

We see from (10) that $\frac{dL_M(s)}{ds} = -\frac{1}{f''_M} > 0$. From (11), we can next see that :

$$\frac{dL_A(s)}{ds} = \frac{\left\{ \frac{\bar{w}}{1-L_A} - f'_A f'_M \frac{(U_{12}U_2 - U_{22}U_1)}{U_2^2} \right\} \frac{dL_M}{ds}}{\left[\frac{U_1}{U_2} f''_A + \left(\frac{U_{11}U_2 - U_{12}U_1}{U_2^2} \right) (f'_A)^2 - \frac{\bar{w} L_A}{(1-L_A)^2} \right]}.$$

The denominator of this expression is negative but the sign of the numerator is positive if U is linear but indeterminate if U is non-linear. Substituting this in the expression for $\frac{dU}{ds}$, and using (10) and (11), we then get :

$$\frac{dU}{ds} = \frac{U_2\left[\frac{\bar{w}L_M}{1-L_A}\left\{\frac{\bar{w}}{1-L_A} - f_A' f_M'\left(\frac{U_{12}U_2-U_{22}U_1}{U_2^2}\right)\right\} + (\bar{w}-s)\left\{\frac{U_1}{U_2} f_A'' + \left(\frac{U_{11}U_2-U_{21}U_1}{U_2^2}\right)(f_A')^2 - \frac{\bar{w}L_M}{(1-L_A)^2}\right\}\right]}{\left[\frac{U_1}{U_2} f_A'' + \left(\frac{U_{11}U_2-U_{12}U_1}{U_2^2}\right)(f_A')^2 - \frac{\bar{w}L_M}{(1-L_A)^2}\right]}$$

$$= \frac{U_2\left[\frac{s\bar{w}L_M}{(1-L_A)^2} + (\bar{w}-s)\frac{U_1}{U_2} f_A'' - \left(\frac{\bar{w}L_M}{1-L_A}\right) f_A' f_M'\left(\frac{U_{11}U_2-U_{22}U_1}{U_2^2}\right) + (\bar{w}-s)\left(\frac{U_{11}U_2-U_{21}U_1}{U_2^2}\right)(f_A')^2\right]}{\left[\frac{U_1}{U_2} f_A'' + \left(\frac{U_{11}U_2-U_{12}U_1}{U_2^2}\right)(f_A')^2 - \frac{wL_M}{(1-L_A)^2}\right]}$$

The sign of $\frac{dU}{ds}$ is clearly indeterminate even if U is linear because the numerator is of indeterminate sign though the denominator is negative.

However, not all is lost. For, all terms except for $s\bar{w}L_M/(1-L_A)^2$ are negative in the numerator; and this term should vanish when $s = 0$. Hence $\frac{dU}{ds} > 0$ when $s = 0$, i.e. under *laissez faire* : in other words, *laissez faire* is a sub-optimal policy and a wage *subsidy* would be welfare-improving.[14]

It is also clear that the full-employment-yielding subsidy $_s$ may not be the second best optimal subsidy, and that it need not even be superior to *laissez-faire.*

4. Production tax-cum subsidy

We now consider the policy of subsidising production in agriculture. To do this, we must now rewrite the equilibrium conditions as follows :

$$f_M' = \bar{w} \qquad \ldots \quad (12)$$

$$\pi_p f_A' = \frac{\bar{w}L_M}{1-L_A} \qquad \ldots \quad (13)$$

where π_p is the producer's price of the agricultural good, so that the implied production tax-cum-subsidy can be derived as $[\pi_p - U_1/U_2]/(U_1/U_2)$.

As before, (12) yields a unique value $\bar{L}_M$ for L_M. Again, as in the case of (11), the left hand side of (13) is a *decreasing* function of L_A and the right hand side is an

[14]Note however that, if we take the linear utility function case *and* assume that $F'' = 0$, $dU/ds = 0$ at laissez-faire so that a wage subsidy will reduce agricultural output and a zero wage subsidy will be the optimal wage subsidy.

increasing function of L_A. And the two sides are graphed in Figure 8. Note again that the left hand side of (13) is an *increasing* function of π_p, for given L_A, and the right hand side now is *independent* of π_p.

Hence, for each π_p in $(0, \bar{\pi}_p)$, where $\pi_p f'_A = \bar{w}$ (i.e. π_p is the price-ratio that yields full employment), a unique $L_A(\pi_p)$ exists that satisfies (13) and lies in the range $(0, 1-\bar{L}_M)$.

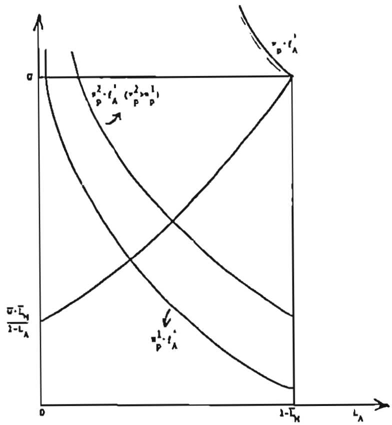

Fig. 8

The *laissez faire* value of π_p equals U_1/U_2 where $\frac{U_1}{U_2} f'_A = \frac{\bar{w}L_M}{1-L_A}$. As π_p increases furthermore, it is evident from both Figure 8 and the underlying algebra, that L_A increases as well, thus increasing X_A, while X_M remains unchanged because L_M remains unchanged at $\bar{L}_M$. Hence *both* economic welfare (U) and employment clearly increase as π_p is increased from its *laissez faire* value to $\bar{\pi}_p$, its full-employment value. Thus clearly the second-best optimum is attained when $\pi_p = \bar{\pi}_p$.[15]

[15]It is easy to see that the *laissez faire* value of π_p is strictly less than $\bar{\pi}_p$. For, if it were the same, then we would have $\bar{\pi}_p f'_A = f'_M$, and $\pi_p = U_1/U_2$, so that $U_1/U_2 = f'_M/f'_A$, which is impossible because this condition can obtain in full employment only at the first-best optimum—a situation ruled out by the fact that *laissez faire* is assumed to be characterised by a binding, rigid-wage constraint.

Note finally that we are not able to rank the second-best optimum wage subsidy (to manufacturing) and the second-best production subsidy to agriculture.[14]

5. Optimal policy intervention

Finally, it is easily demonstrated that if the two policies (considered in Sections 3 and 4) can be *simultaneously* applied, the first-best optimum can be reached.

This is done simply by determining the optimum levels of the two instruments and showing that the necessary constraints are met. Thus, let :

$$s^* = \bar{w} - f'_M(L^*_M)$$

be the wage subsidy. Let :

$$\pi^*_p = \frac{\bar{w}}{f'_A(L^*_A)}$$

be the producer's price of the agricultural good. Let :

$$\pi^*_c = \frac{U_1(X^*_A, X^*_M)}{U_2(X^*_A, X^*_M)}$$

be the consumption price of the agricultural good, such that

$$t^* = \frac{\pi^*_p - \pi^*_c}{\pi^*_c}$$

is the optimal production subsidy to agriculture. With these values for s^* and π^*_p, we have :

$$f'_M = \bar{w} - s^* \qquad \text{... (14)}$$

$$\pi^*_p f'_A = \bar{w} = \bar{w} \, . \, \frac{L^*_M}{1 - L^*_A} \qquad \text{... (15)}$$

so that it is clear that the constraints in the model are met (i.e. the wage rate in manufacturing is at $\bar{w}$, and the wage rates are equalised at the producer's prices in both sectors) and full-employment, optimal equilibrium is reached with wage subsidy at levels s^* and production subsidy to agriculture at rate t^*.

Note also that the *same* optimal equilibrium can be equivalently obtained by dropping the production subsidy and instead extending the wage subsidy at level s^* to agricultural employment as well. In this case, we should write :

$$f'_M = \bar{w} - s^* \qquad \text{... (16)}$$

$$\pi^*_c \, . \, f'_A = \bar{w} - s^* . \qquad \text{... (17)}$$

[14] In fact, we have been able merely to prove the *existence of* a second-best wage subsidy, without being able to determine its value explicitly.

In either case, the equilibrium production will be identical. However, as illustrated in Figure 9, where S is the first-best optimum for a closed economy, production under the uniform wage subsidy will be given by the *tangency* of π_p^* to the production possibility curve DE whereas, under the wage subsidy (to manufacturing) *plus* production subsidy to agriculture, it will be characterised by non-tangency of π_p^* to DE at S.

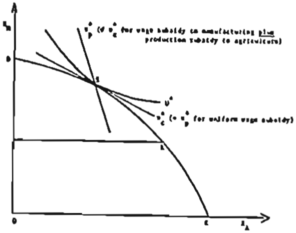

Fig. 9. S is the first-best, optimum for a closed economy, with the social utility curve U^* tangent to the production possibility curve DE. A suitable, uniform wage subsidy to both sectors, A and M, will equate the consumption and production prices with the domestic rates of transformation in production and substitution in consumption at S. A suitable wage subsidy to manufacturing *plus* production subsidy to agriculture will not equate the consumption and production prices but will equate the two rates of substitution in consumption and transformation in production at S with each other and with the consumption price alone.

6. Concluding remarks

Finally, we may note explicitly that an attempted extension of our policy rankings to actual policy implementation would have to take into account the following, well-known problems.

(i) The administration costs *and* feasibility of alternative policies must be taken into account.

(ii) Since taxes must be collected to disburse subsidies, the question arises whether those who ask for minimum real wages will not, even when such taxes are imposed on them in a lumpsum fashion, seek to revise the minimum real wage that is demanded. We have assumed, of course, that the minimum real wage demanded is independent of the tax policy chosen.

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Paper received : August, 1973.